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Rough calculations have indicated that in regions where local solid fuels are available it is cheaper to haul cargo by steam-driven rather than by gasoline-driven engines.

Three basic trends have been set in the development of contemporary steam vehicles. Low-pressure types are receiving the widest distribution. The fuel system in low-pressure types has a broken circuit which allows escape of the exhaust steam through a pressure cone into the atmosphere.

For compactness the boiler complex of these vehicles is set between the longitudinal girders of the chassis inside the drivers cab. Although this arrangement insures simplicity of construction and symmetrical grouping of the boiler complex, the firebox and fire-grate bar cannot be sufficiently built up and equipped to burn low caloric types of solid fuel. Low-pressure steam vehicles can operate successfully only on high caloric coal. The fire-grate bar set between the girders eliminates the possibility of setting up multigear motor vehicles with front-wheel drive.

Despite its simplicity the low-pressure steam engine is not general purpose and cannot be used in many types of motor vehicles. The use of a boiler and firebox presents serious difficulty to the driver.

Circulation boilers of 300-liter capacity are used as steam generators in low-pressure steam in vehicles. Vertical boilers with crosshead flues are most widely used. Boiler pressure does not exceed 20 atmospheres. Supply of water to the boiler and regulation of combustion is usually not automatic, and two men must service the machine while it is in operation.

Single expansion engines used in contemporary steam vehicles are fed by steam distribution valves. The engine is set directly behind the boiler, between the boiler and the bed, or suspended below the girders. Despite their many defects and their unwieldiness, low-pressure steam vehicles are being built in large numbers because of their simplicity and durability and the low cost of the fuels they burn.

The second type of steam vehicles, those having high pressure plants, operate in closed circuits with complete condensation of exhaust steam. Uniflow coil boilers, which operate on liquid fuel, chiefly light fractions of petroleum, are usually used as steam generators in these vehicles. Boiler pressure reaches 100 atmospheres and superheating temperature, 450 degrees centigrade. The work of the boiler and auxiliary equipment is completely automatic.

These motor vehicles are not too widely distributed because of the nature of the fuel used and the complexity of the heating system.

Steam-driven motor vehicles with medium-pressure plants, which have appeared in recent years, have comparatively simple heating systems and operate on solid fuel. High-caloric coal or briquettes are used as fuel. The fuel falls from the bunkers into the fire-grate bar, in accordance with the rate of burning, under the action of its own weight or with the assistance of simple mechanical devices. The boiler complex used in these plants generally has natural circulation and requires a small amount of water. As a result, despite the pressure of a condenser, medium-pressure steam vehicles require less weight per unit of pressure than low-pressure vehicles.

To facilitate servicing of the firebox in steam vehicles of this type, the boiler complex was set up asymmetrically. This is the chief defect. The lateral position of the boiler and the flue devices has been generally utilized and is achieved by shifting the engine and other units of the steam plant to the opposite side. This shift complicates the layout, decreases the clearance of the vehicle, and eliminates the possibility of building multigear motor vehicles.

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In 1948 the members of the NAMI Steam-driven Motor Vehicle Bureau built in NAMI-012 steam truck according to their own models and completely different from the types discussed above.

The NAMI-012 operates on low-calory solid fuel, especially on wood since it was intended primarily for the timber industry. It is mounted on the standard chassis of the mass-produced InAZ-200 heavy truck, but it can be modified for use on various chassis, including multigear types with front wheel drive.

There is a three-seat cab for the drivers located over the front axle. The motor and the complete steam plant are set behind the driver's cab under a special hood.

There is a vertical three-cylinder steam engine in the engine in compartment. The rear wall of this compartment forms the shell of a tubular boiler. There are two fuel bunkers along the sides of the boiler. Behind the bunker the truck bed is standard.

The right wall of the engine compartment is a wall of the water tank in which the condenser is located. In addition to the condenser there are exhaust-steam turbines with axial vents and centrifugal heat blowers. The power pump, which directly supports the gear box of the steam engine, and the direct steam feed pump, which is set beside the chassis girder are both located to the left.

All equipment which requires servicing during use is set to the left side of the engine compartment. The steam distribution valve is also set to the left of the cylinders.

The boiler complex is set saddle-wise in the frame of the automobile in order to accommodate the transmission, the distributor box and the steering rods. The fire-grate bar of the boiler is broken up into two halves and set symmetrically outside the girders of the frame under the fuel bunkers. The steam and waste gas heaters are located above the fire-grate bar between the bunkers. By this arrangement sufficient space is provided for the transmission and the distributor box and for the height of the flame which is very important in burning wood.

The design of the firebox permits the fuel to fall into the fire-grate bar from the fuel bunkers by the force of the fuel's own weight according to the rate of burning. This procedure frees the driver from continuous feeding of fuel. The fuel bunkers hold about 0.85 cubic meters of wood 50 x 10 x 10 centimeters. The lower part of the fuel bunkers and the firebox are protected by shields.

The centrifugal blower which furnishes the air necessary for combustion is under the fire-grate bar. After passing out of the fire, the products of the combustion enter a central gas passage in which are located the steam and waste gas heaters.

Practice has indicated that the firebox operates at an excess air coefficient of 1.15-1.20. Losses due to chemical impurities are 4-5 percent.

A small, vertical, 60-liter drum is set outside the boiler to provide circulation. It joins the circulation pipes to the water and steam collectors of the boiler. The steam productivity of the boiler reaches 600 kilograms per hour with a pressure of 25 atmospheres and superheating of 400-425 degrees centigrade. The efficiency of the boiler complex under average and very heavy loads is 70 percent.

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The diameter of the steam engine cylinders is 125 millimeters; the piston stroke is 125 millimeters. The engine develops 100 horsepower at 1,000 revolutions per minute. The maximum number of revolutions per minute is 1,250. The steam distribution valve permits 3 degrees of intake in forward drive (75, 40 and 25 percent) and one in reverse drive (80 percent).

A choke helps regulate the steam pressure entering the engine's cylinders. The driver controls this choke by means of a pedal located where the ordinary motor vehicle has an accelerator.

The NAMI-012 has the same number of levers and pedals as ordinary trucks, except for the gear shift being replaced by a reverse shift and a cut-off.

Tests of the NAMI-012 have indicated that it will not only operate on wood of standard quality (moisture content, 35 percent) but even on much poorer wood. In a test the NAMI-012 operated on rotten wood with a moisture content of 49 percent, the heating capacity of which did not exceed 1,500 calories per kilogram. Despite the poor quality of the fuel the truck retained its usual drive and pick-up. The only change was the need for more frequent fueling.

#### Characteristics of the NAMI-012 Steam-Driven Truck

Load capacity	6 tons
Service weight	14 tons
Empty weight	7.3 tons

#### Percentage of load on forward axle:

Empty vehicle	51
Loaded vehicle	30

#### Percentage of load on rear axle:

Empty vehicle	49
Loaded vehicle	70

Maximum speed	42 km/hr
Gear ratio of main transmission	5.96
Gear ratios of reverse transmission	1 and 2.22
Size of tires (forward-single, rear-double)	12.00 x 20
Capacity of fuel bunkers (moisture content 35 percent)	320 kg
Capacity of water tank	200 liters

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